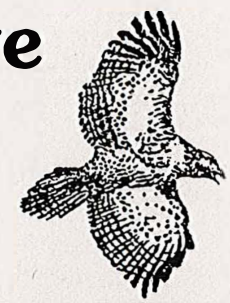
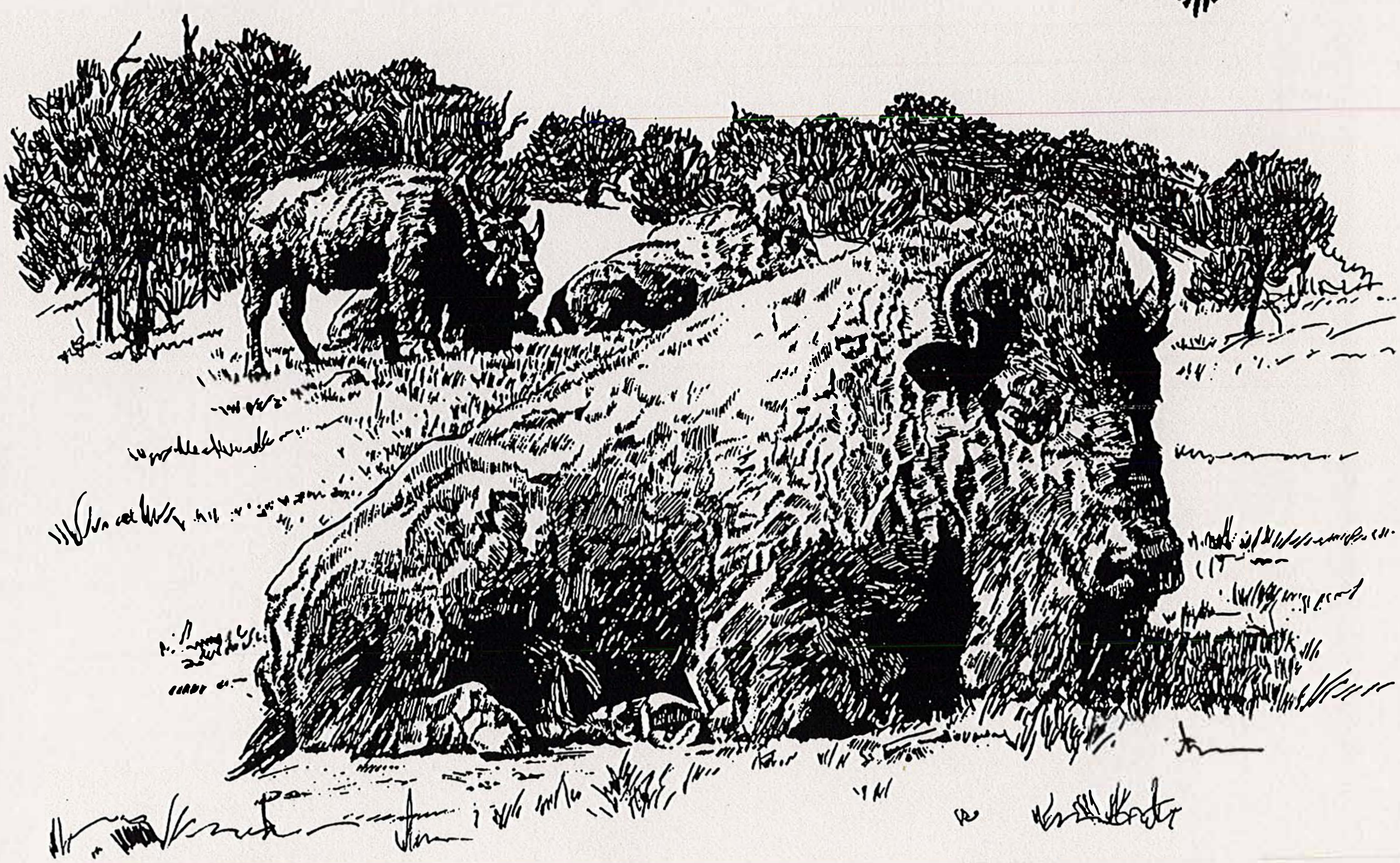
Integrated Pest Management
&
Forest Health
for
Sullys Hill
National Game Preserve

Report No. 91-11





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Reply to: 3420

Date:

North Dakota Cooperators

The USDA Forest Service has been designated by Congress to advise and assist other Federal agencies on forest pest related issues and concerns. The North Dakota Forest Service has been a valuable cooperator in assisting the USDA Forest Service in this responsibility in North Dakota. The US Fish and Wildlife Service, which administers Sullys Hill National Game Preserve, has taken the initiative in addressing forest health issues on the Preserve and is the lead agency in plan implementation.

The following report represents a multi-agency and multi-disciplinary integrated approach to identifying and understanding ecological processes, damaging agents and the options available to achieve forest health on Sullys Hill National Game Preserve.

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INTEGRATED PEST MANAGEMENT AND FOREST HEALTH

for

SULLYS HILL NATIONAL GAME PRESERVE

by

William Antrobius, Entomologist, USDA Forest Service

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Craig Brumbaugh, Northeast District Forester, North Dakota Forest Service

Steve Kresl, Outdoor Recreation Planner, U.S. Fish and Wildlife Service

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INTRODUCTION

Sullys Hill National Game Preserve is located on the south shore of Devil's Lake in the northeastern corner of North Dakota. The Preserve covers approximately 1,675 acres. The rolling, glacial moraine hills were formed approximately 12,000 years ago when glaciers advanced and then receded. Today, the ridge tops are covered with almost pure forests of bur oak, with mixed forests of box elder, basswood, green ash, white burch, and American elm occurring on slopes and in kettles or bowls. Over the years, the ridge-top oaks have partially colonized the surrounding slopes. Native grasslands are also present. The Preserve is home to bison, elk, white-tailed deer and other species of flora and fauna.

On August 21 and 22, 1991, Arden Tagestad and Craig Brumbaugh with the North Dakota Forest Service, and Bill Antrobius with the USDA Forest Service, visited Sullys Hill National Game Preserve to continue investigations related to tree defoliation, crown dieback, and tree mortality on the Preserve's deciduous tree resource (Appendix A, Service Trip Report June 13, 1991). We were accompanied by Keith Fitzpatrick, a summer technician working under the direction of Steve Kresl, Outdoor Recreation Planner for the Preserve. The crown dieback and tree mortality observed at the Preserve have resulted from a number of interacting agents, including insects, diseases and abiotic factors.

This report represents a multi-agency and multi-disciplinary integrated approach to identifying ecological processes, damaging agents, priority management areas, and options available to achieve forest health on the Preserve. Methods, observations, forest management recommendations, and options available are presented.

METHODS

Based on previous observations and subsequent follow-up discussions, we established nine permanent plots in forest types where spring and fall cankerworm and two-lined chestnut borer activity has occurred in the past (Appendix B, map and photo overlay). Variable radius plots were established using a 10-factor basal area prism. Variables related to individual tree health, individual tree characteristics, and site characteristics were summarized following plot establishment. Tree species composition and relative percentages were also determined for each plot.

Variables measured to determine tree health in plots were: (1) tree crown dieback, expressed as a percentage of total crown area, (2) percent of diseased trees in plots based upon either the presence or absence of fungal fruiting bodies (conks), or branch and leaf mortality associated with Dutch elm disease, (3) percent of tree mortality in plots by species, and (4) the presence or absence of the two-lined chestnut borer on bur oak.

Variables measured for plot tree characterizations were: (1) diameter at breast height, (2) tree height, (3) growth rates within the last 10 years on selected species, and (4) age of selected species.

Site characterization variables included: (1) basal area (basal area estimates were made using a BAF-10 prism with observation points spaced approximately 132 feet apart), (2) slope percent, (3) aspect, (4) the presence or absence of regeneration for five tree species found on the Preserve (estimates were made by sampling 1/1000-acre plots within permanent plots), and (5) percent cover by grass and shrubs.

In an effort to determine forest stands that were in the poorest health and in need of earliest treatments, inventory data were correlated with stand structure from aerial photographs (Color IR Scale 1:7920). Stands with similar percent crown dieback, density (basal area), size class (d.b.h.), and regeneration were grouped together and then ranked.

The most important factor used to determine stand risk and general health was amount of crown dieback present. Zero to 30 percent crown dieback was considered light, 30 to 60 percent dieback was considered moderate, and over 60 percent dieback was considered heavy.

Understory regeneration was also used to prioritize stands for treatments. Stands with less than 500 trees/acre in the understory were considered to have poor regeneration. Stands with 500-1,500 trees/acre were considered to have moderate regeneration, and stands with over 1,500 trees/acre were considered to have good regeneration.

Stands with a high incidence of crown dieback and low regeneration were given highest priority for treatments. Areas exhibiting moderate susceptibility and moderate regeneration were given intermediate priority for treatments. Stands with low susceptibility to insect and disease and which exhibited good regeneration were given low priority for treatments.

Given the intensity of inventory (nine plots per 328 acres) stands were not delineated smaller than 30 acres. Because of lower insect and disease hazard, 160 acres in the southwest corner of the property were not inventoried. In addition, a 150- to 300-foot buffer strip north of the highway and on the far east side of the property was not included in the inventory.

Data were analyzed using standard analysis of variance (ANOVA). A level of significance with $P=0.05$ was used in the analysis.

RESULTS AND DISCUSSION

Damaging Agents Affecting Forest Health:

Based upon our observations, significant crown dieback and tree mortality were found associated with the bur oak component of the Preserve's tree resource (Table 1). In the pure bur oak forest type, crown dieback on individual trees ranged from 68 to 100 percent with an average of 78 percent (Figure 1). Mortality in plots placed in the pure bur oak forest type ranged from a low of 18 to a high of 100 percent, and averaged 51 percent.

Table 1.--Species composition and percentage, average tree crown dieback (expressed as a percentage of total crown area), percent disease trees, percent of tree mortality, and the presence or absence of the two-lined chestnut borer for placed at Sullys Hill National Game Preserve (data collected in August 1991).

Plot #	Tree Species and Percent	Average % Dieback	% Disease	% Mortality	Two-lined Chestnut Borer
1A	B.wood = 60.0 G.ash = 10.0 B.oak = 20.0 A.elm = 10.0	20.0 5.0 55.0 10.0	0.0 0.0 0.0 0.0	17.0 0.0 0.0 0.0	Yes
2A	B.oak = 90.0 G.ash = 10.0	42.0 15.0	0.0 0.0	11.0 0.0	Yes
3A	B.oak = 100.0	68.0	0.0	36.0	Yes
4A	B.oak = 100.0	66.0	0.0	18.0	Yes
5A	G.ash = 83.0 A.elm = 17.0	24.0 52.0	40.0 0.0	20.0 50.0	No
6A	B.wood = 93.0 B.elder = 7.0	5.0 10.0	0.0 0.0	0.0 0.0	No
7A	B.oak = 63.0 G.ash = 37.0	82.0 11.0	0.0 33.0	20.0 0.0	Yes
8A	B.oak = 100.0	100.0	0.0	100.0	Yes
9A	B.oak = 92.0 B.elder = 8.0	29.0 100.0	0.0 0.0	8.3 0.0	Yes

B.wood = basswood; G.ash = green ash; B.oak = bur oak; A.elm = American elm; B.elder = box elder.

Figure 1.--Crown dieback occurring on bur oak at Sullys Hill National Game Preserve (photo taken in August 1991).

In mixed forest types where bur oak is present, oak crown dieback ranged from 29 to 82 percent with an average of 52 percent. Mortality of bur oak in the mixed forest types ranged from 0 to 20 percent. The average mortality of bur oak in these plots was 10 percent. Crown dieback and mortality associated with the other four species of hardwoods was found, but was not as extensive as that found on the bur oak component.

A statistical analysis was performed to determine if crown dieback was significantly different between plot trees found in pure bur oak forest types and those found in mixed forest types. Dead trees were included in this analysis and were given values of 100 percent crown dieback. Based upon sample data, a significantly higher level of crown dieback was found in pure forest types of bur oak when compared to mixed forest types ($p > 0.0005$; $F = 25.32$). It was evident that mixed forest types were not as impacted by crown dieback as pure bur oak forest types.

Several reasons are given for these differing levels of impact. Pure bur oak forest types were found mainly on ridge tops where drier conditions exist. The two-lined chestnut borer prefers bur oak trees which have been weakened by drought, or defoliation and have as a consequence low root starch reserves. Two of these impacts, drought and defoliation, have occurred on the Game Preserve's tree resource within the last 5 years. It is suggested that the additive effects of defoliation, drought and generally dry site conditions contributed greatly to the susceptibility of ridge top bur oak to two-lined chestnut borer.

Areas with better moisture conditions including slope and bowl areas were generally found to have a mixture of species including green ash, American elm, box elder, basswood, and/or bur oak. Since bottom land hardwoods generally colonize and do best in areas where moisture conditions are relatively good, bur oak which establishes itself in association with these species would also experience better moisture conditions. This probably contributed to the ability of bur oak found on these sites to "ward off" attacks by the two-lined chestnut borer.

Bottom land hardwoods present in mixed forest types are not preferred by the two-lined chestnut borer and thus did not exhibit substantial crown dieback from this agent. The limited amount of crown dieback that was found on bottom land hardwoods in mixed forest types can be attributed to other agents or natural processes including insect defoliators, disease and age. We suggest that in areas where moisture is limited, and where bur oak is found, impacts by the two-lined chestnut borer will occur in greater frequency and intensity than in areas where moisture conditions are better, such as on north and east facing slopes and bowl areas.

Surface soil compaction, as a result of herbivore grazing, cannot be ruled out as a contributing factor in declining forest health, especially on ridge tops. Spurr and Barnes (1980) report that grazing by large animals can result in substantial changes in the forest site, and that compaction of the surface soil can result in the destruction of soil aggregates. This in turn affects the ability of the soil to absorb water and impedes the process of aeration to underlying root systems. It is most probable that compaction is occurring on the Preserve's surface soil, but the exact extent is still unknown.

The age and general health of the tree resource contributes to its ability to withstand impacts by insect and disease organisms (Table 2). It is worth noting, however, that insect and disease processes occur naturally and interactively as stands age and contribute toward a complete cycle of stand regeneration. A question is raised as to whether or not the Preserve's tree resource can attain it's "natural biological rotation age" given the alterations to it's environment. Elias, (1980) suggests that bur oak continues to fruit well beyond 200 years of age in parts of its range. In Michigan, where moisture conditions are more favorable, the species is reported to be long-lived and reaches ages of 200-300 years or more (Barnes and Wagner, 1989). Reference collection specimen show the species can be long-lived (300 plus years) in North Dakota, as well.

Signs of disease agents, *Ceratocystis ulmi* on American elm (fading crowns and dying branches), and those associated with *Perenniporia fraxinophila* (syn. *Fomes fraxinophilus* (Peck) Sacc.) stem decay of green ash (fungal fruiting bodies), were observed. Mortality of American elm was also observed. Levels of stem decay in the green ash component were significant when found, but only two of the nine sampled sites exhibited signs, such as fungal fruiting bodies of the disease. This disease has been known to be present without exhibiting fruiting bodies.

It is most probable that some or all of the above-mentioned conditions, both natural and human induced, are interacting and contributing to the dieback and mortality found on the Preserve's tree resource. This is most apparent on ridgetop ecosystems. It is also apparent that some forest types are in a better state of "health" than others; these generally occur on north-facing slopes and in bowl areas (Figure 2).

Table 2.--Species composition, average tree diamter by species, height, age, and growth rates for the last 10 years, Sullys Hill National Game Preserve (data collected in August 1991).

Plot #	Tree Species	Avg. Diameter (breast height)	Avg. Height (ft.)*	Avg. Age	Avg. 10-yr. tree growth (mm)
1A	B.wood G.ash B.oak A.elm	11.3 7.5 4.9 8.9	34	116.0	7.0
2A	B.oak G.ash	8.0 8.0	34	98.5	8.0
3A	B.oak	8.0	30	100.5	9.5
4A	B.oak	8.4	30	99.5	8.0
5A	G.ash A.elm	10.6 13.9	60	103.0	12.0
6A	B.wood B.elder	10.4 8.3	50	NA	NA
7A	B.oak G.ash	8.2 11.1	40	98.0	6.0
8A	B.oak	9.7	30	104.5	7.5
9A	B.oak B.elder	9.0 4.7	50	91.5	12.0

* Heights are for all species averaged.

Figure 2.--Aerial photograph of crown dieback and tree mortality at Sullys Hill National Game Preserve (photo taken in July, 1991).

We can expect additional impacts by the two-lined chestnut borer to occur in both pure bur oak and mixed systems which contain bur oak. The intensity of impacts could decrease if moisture conditions continue to improve as they have in 1991. Similarly, impacts by spring and fall cankerworms can also be expected to continue at some level in the future. When they occur, impacts will be especially noticeable on the green ash and box elder component. The ability of the Preserve's trees to withstand repeated defoliation by these organisms is improved when moisture conditions are favorable. Further, we can expect the buildup of a natural enemy complex as pest populations continue their natural cycle. These, when present in sufficient numbers, can help to reduce pest populations and their impacts over time.

Ecological Processes and Impacts on Regeneration:

In the past, defoliation by insects, and stem breakage caused by heart rotting fungi as trees aged, allowed light to reach understory regeneration during the spring growing period. These processes, in association with repeated fires, probably contributed to maintaining the site in woody plant species. Outbreaks of the two-lined chestnut borer, which cause limb and tree mortality, indirectly contribute to fuel loads which could help carry a fire once started. The dryer ridge tops, where more frequent fires likely occurred, are ideal habitat for the fire-tolerant bur oaks.

Frequent fires most likely restricted the bottom-land species such as box elder, green ash, American elm and basswood to moister sites--such as slopes and bowl areas. Without fire, bottom-land hardwood species eventually begin their colonization of the less favorable sites existing on the ridge tops. Evidence suggests this is now occurring (Table 3). Regeneration, when found, in plots was of American elm, box elder, or green ash, but was seldom above one-half foot in height. Bud and stem clipping by herbivores was also apparent on most of this regeneration.

Table 3.--Plot parameters including slope percent, aspect, the presence or absence of woody plant regeneration, percent cover by grass and/or shrubs, and average stand basal area (BA) estimates for Sullys Hill National Game Preserve (data collected in August 1991).

Plot #	Slope %	Aspect	Woody Plant Regeneration	% Cover Grass/Brush	Stand BA*	
1A	15	N	G.ash = 3,000/ac	60 grass 40 brush	100.0	
2A	14	SSE	None	70 grass 30 brush	93.0	
3A	9	W	None	80 grass 55 brush	93.0	
4A	14	ESE	A.elm = 3,000/ac G.ash = 2,000/ac	80 grass 50 brush	106.0	
5A	18	NE	None	90 grass 15 brush	133.0	
6A	15	NE	B.elder = 1,000/ac A.elm = 1,000/ac	90 grass 20 brush	130.0	
7A	25	NW	None	100 grass 60 brush	110.0	
8A	10	NNE	None	90 grass 60 brush	87.0	
9A	13	E	A.elm = 1,000/ac	30 grass 60 brush	120.0	

* BA = Basal area estimates were made using a BAF-10 prism with observation points spaced approximately 132 feet apart.

Figure 3.--Multiple stems of bur oak on Sullys Hill National Game Preserve (photo taken in August 1991).

It is known that many sites on Sullys Hill were logged at or around the turn of the century when demand for wood in the area was high. Indeed, evidence of this activity is apparent in the many examples of multiple stems originating from one stump or root base (Figure 3). This is strong evidence that stump sprouting or coppice regeneration has occurred. Logging operations performed early in this century have most likely resulted in the regeneration of much of the Preserve's present day tree resource. The associated root systems may well be over 200 years old.

Oak regeneration was not observed during sampling. Oak regeneration was observed, however, on lands adjacent to the Preserve where herbivore activity is restricted. Bur oak found in North Dakota is generally considered to be near the western edge of its range.

Herbivores have without doubt been present in the past, but their impacts and role in site regeneration are largely unknown. It is suggested however, that prior to European settlement grazing activities by large herbivores, including buffalo, was seasonal and intermittent. Spurr and Barnes (1980) suggest that browsing and grazing by herbivores can change vegetation patterns through their selective feeding habits (Figure 4).

Figure 4.--Bottomland hardwoods system showing a lack of woody plant regeneration, with fuel loads apparent (photo taken in August 1991).

Priority Forest Management Areas.

Priority rankings for management intervention, based on criteria given in the methods section, are given in Table 4. Rankings were included to help management make maximum use of limited resources and time. Stands are identified by associated plot numbers.

Table 4.--Treatment priority areas by stand/plot locations with corresponding acreages, average stand composition, d.b.h., average regeneration levels, and slope and aspect for Sullys Hill National Game Preserve, 1991.

Treatment Priority	Stand	Acreage	Stand Composition	Average d.b.h. (in).	Average Regeneration	Slope/Aspect
1	3A,4A 7A,8A	65	92% bur oak 8% green ash	8.7	<500/acre Poor	Wide range Xeric to mesic
2	2A	51	90% bur Oak 10% green ash	8.1	<500/acre Poor	14% SSE Xeric to mesic
3	9A	32	92% bur oak 8% boxelder	8.1	1,000/acre Moderate	13% East Mesic
4	1A,5A 6A	180	44% basswood 7% Amer. elm 3% green ash 2% boxelder	6.2	2,700/acre Good	14-17% North to Northeast Mesic

OPTIONS AVAILABLE

If managers of the Preserve decide to maintain the forest types now present, several options are available to achieve this management objective. These options can be implemented singly or in combination:

1. ***Regenerate selected forest types by coppice in field trials.*** All tree species found on the Preserve have the potential to sprout from the roots, root collar or stem. In nature, this usually occurs as a result of fire activity or through main stem breakage. Coppice reproduction would require cutting a significant number of trees in the older age classes to be successful. Trees selected for this method of regeneration should have a viable root. In most cases dead crowns indicate dead root systems as well. In some of the pure oak systems it may be too late to attempt this method of regeneration.

Managers of the Preserve may consider a "demonstration" area, limited in size, where this method of regeneration is attempted. Protection, by fencing, from herbivore feeding would most likely be required to ensure sprout survival. The North Dakota Forest Service has offered to assist in setting up a project of this kind. Use of the coppice regeneration method would have the benefits of reducing impacts by the two-lined chestnut borer and spring and fall cankerworms which prefer the older age classes, while promoting vigorous new growth in coppice stumps. In addition, diseased stems (primarily green ash) could be removed, and disease would not become a management concern again until the "new" stand matures. The heart-rotting diseases, including the one found on the Preserve's green ash component, cannot be eliminated entirely, but their effects--broken tops and limbs--can be reduced by promoting vigorous new growth.

Coppice regeneration would have limited effects in reducing the Preserve's Dutch elm disease problem. A more active and costly sanitation and removal program would slow the rate of decline, but even this method of control is questionable in a forest setting where vectors of the disease are present in surrounding ecosystems and outside the Preserve's management area.

The public may respond negatively to the felling of trees. To mitigate the potential of a negative public response to the coppice regeneration method, the Preserve could limit the size, shape, and/or location of coppice stands or demonstration areas. An active education program may help to mitigate the potential for negative responses.

2. Protection of regeneration within exclusion zones. Stress influences associated with surface soil compaction, and the loss of regeneration due to grazing pressures, can be mitigated by identifying the most susceptible stands and then reducing the impacts. The Preserve may consider creating exclusion zones where other vegetation management options can be implemented. Stands with the poorest health may be the first selected for fencing and rehabilitation. As these stands are rehabilitated, they may be reopened for grazing.

The advantages of this option are that it would allow for the continual rotation of areas or stands to be regenerated, and would ensure the continuation of grazing areas with tree cover. This option would have a high probability to perpetuate some portion of the Preserve's tree resource by allowing regeneration now present a chance to establish itself. The disadvantages of this option are the time and costs associated with its implementation and loss of grazing area. It is unknown how long areas would need to be protected. Site differences and tree specie composition would certainly play a major role in determining time intervals.

Expectations of longevity in bur oak, and indeed the other tree species found on the Preserve, may have to be modified given the alterations of their surrounding environment. This shortened "biological rotation" age has implications that should be considered in any scenario of management which includes grazing by large herbivores.

3. Treat future cankerworm infestations with insecticides to "hold" the tree resource until site specific regeneration plans are designed and implemented. *Bacillus thuringiensis*, or *B.t.*, has proven effective against cankerworms and is now an acceptable alternative to chemical pesticides with most publics. Root system protection for coppice reproduction would be a potential benefit. This option is especially attractive when combined with an active program of regeneration. Pesticides applied on a forest level would have little to no impact on the two-lined chestnut borer.

A thorough environmental analysis examining potential impacts to endangered or threatened species is required before treatments could be employed. This process could take approximately 6 to 12 months to complete. A public meeting should be considered where objections or acceptance to treatments may be aired. Our experience has shown that the use of a biological insecticide, such as *B.t.*, greatly increases the chance of public acceptance to spray treatments. The USDA Forest Service may pay for 100 percent of costs incurred for such treatments. If the biological evaluation and economic analysis showed the project to be biologically sound and economically efficient, USDA Forest Service insect suppression dollars can be used for National Environmental Protection Act document preparation.

There are several disadvantages to pursuing this option. First, the use of insecticides can have negative impacts on non-target organisms that are present and feeding on targeted foliage during the time of application. Second, insecticides can be expensive to apply. Timing of applications would be critical, especially when using biological pesticides such as *B.t.* Adverse weather conditions may affect costs and personnel schedules.

4. Plant trees which complement the existing tree resource. The chances of success or failure of this option are difficult to assess. Grasses can effectively compete with seedlings for moisture and nutrients. Moreover, some grasses are known to be allelopathic in nature and can eliminate competition from woody plant species by chemical exclusion. Either chemical or cultural control of competing vegetation may be required to ensure successful establishment and growth of planted seedlings. The use of herbicides would again "trigger" the need for an environmental analysis before application. Tree nurseries have had some

success in limiting the negative impacts associated with grass competition using non-chemical means. We could access these sources if necessary. In addition, areas planted would most likely require protection from grazing pressures until they establish themselves. Seed used in implementation of this option probably could be obtained from nearby forested areas, and would thus ensure genetic and site compatibility.

5. Use prescribed fire to stimulate advanced oak regeneration. Frequent fires have played a significant role in the regeneration processes of oak forests in the eastern United States (Spurr and Barnes, 1980). The primary purpose of this option would be to stimulate advanced oak regeneration through removal of competing understory vegetation. Use of light prescribed fire is not recommended in stands that have little to no advanced oak regeneration as few benefits from this action would result. This option may be implemented more frequently in the future as advanced regeneration becomes established through implementation of other options. Further planning by a fire specialist is recommended before implementation of this option.

Many advantages and disadvantages are associated with the use of prescribed fire to stimulate woody plant regeneration; we present only several of the more important. Use of light prescribed fire reduces competition through the removal of surrounding grass and shrubs. It also has the potential to improve site quality by releasing nutrients stored in litter. The disadvantages of this option are (1) adverse effects on air quality, (2) hot fires can degrade site quality by initiating soil erosion through removal of cover vegetation, (3) potential loss of soil nutrients through volatilization, and (4) fires can spread to surrounding sites, not intended to be burned.

If the Preserve managers decide not to maintain the forest types now present, the no-action option would be implemented.

No action. The Preserve also has a no-action option. Natural and human influenced processes, including disease, insect activity and grazing now operating on the Preserve would be allowed to continue. As a result, the tree resource can be expected to decline further. Browsing by herbivores can be expected to continue to impact regeneration now present. Fuel loads, especially on ridge tops, can be expected to increase as oak systems decline further. The main benefit of this option would be to allow forest types present to function and adapt to existing environmental conditions. A public education program, which explains the reason for the decline of the tree resource, especially on ridge tops, may reduce negative public reaction to this option.

SUMMARY

Many of the Preserve's forested areas are experiencing significant and extensive impacts by a multitude of agents, both natural and human induced. The natural processes that took place in the past and which are responsible for the presence of forest types found today, have been altered. It would appear that grazing is affecting the amount and kind of regeneration found on the Preserve. An improvement in forest health and perpetuation of existing forest types almost certainly will require management intervention of some kind. Management options given above provide alternatives for managing the vegetative resource. Other options may exist.

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ACKNOWLEDGMENTS

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APPENDICES

Appendix A. Service Trip Report to Sullys Hill National Game Preserve, June 13, 1991

United States Department of Agriculture | Forest Service | Region 1 | Federal Building
P.O. Box 7669
Missoula, MT 59807

Reply to: 3420

Date: June 13, 1991

Mr. Roger Hollevoet
U.S. Fish and Wildlife Service
Sullys Hill National Game Preserve
P.O. Box 908
Devils Lake, ND 58301

Dear Mr. Hollevoet:

On May 17, Bill Antrobius, entomologist on our staff, and Arden Tagestad, pest specialist with the North Dakota State Forester's Office, visited with Steve Kresl, Outdoor Recreation Planner, to discuss an investigation and evaluation of insect damage occurring on the deciduous trees at Sullys Hill National Game Preserve.

After preliminary observations of the Preserve's tree resource and during following discussions, it was apparent that additional surveys would be necessary to determine the extent and intensity of insect and disease organisms impacting the Preserve's tree resource. The enclosed trip report documents observations made, damage agents identified, and further surveys that need to take place at the Preserve.

I hope this information is useful to you. If we can be of further assistance, please feel free to contact us.

Sincerely,

/s/ John H. Thompson (for)

DAVID M. SPORES
Director
Timber, Cooperative Forestry,
and Pest Management

Enclosure

cc:
Arden Tagestad - North Dakota Forest Service
William Antrobius - TCFPM
Jed Dewey - TCFPM

TRIP REPORT
Sullys Hill National Game Preserve
May 17, 1991

On May 17, Arden Tagestad, Forest Pest Specialist with the North Dakota Forest Service, and I met with Steve Kresl, Outdoor Recreation Planner, to investigate and evaluate the insect damage occurring on the deciduous trees at Sullys Hill National Game Preserve.

Prior to this trip, Arden and I made a brief visit to the Preserve in the summer of 1990 to obtain branch samples from impacted trees. Subsequent examinations of the branch samples revealed the presence of extensive galleries and feeding larvae. Larvae found were reared to the adult stage to aid in their identification. The adults were identified as those of the two-lined chestnut borer, *Agrilus bilineatus* (Weber). The borer, in the family Buprestidae, is commonly referred to as a flatheaded borer.

The two-lined chestnut borer is found in southern Canada and throughout the eastern United States. The borer prefers trees weakened by drought, defoliation or trees which have low root starch. The borer is considered by some to be a secondary attacker. Oaks, including bur oak, are preferred hosts. Overwintering is spent as fourth instar larvae in pupal cells located in the sapwood or occasionally in the bark. Adults emerge in spring after boring a characteristic D-shaped exit hole in the bark. The adults mate and the female deposits her eggs on the bark of the host in late spring or early summer, depending on temperatures. Hatching larvae then bore back into the bark until they reach the phloem where they begin to feed in the inner bark and outer wood surfaces. It is during this time that damage is done to the trees. Larvae mine extensive and elaborate "tunnels" as they feed, and effectively girdle stems and branches. As populations increase and trees are weakened, attacks shift from the tops of trees to the larger branches and main trunk.

During this trip, preliminary observations were made on the Preserve's tree resource. Extensive crown dieback (often exceeding 50 percent) and limited tree mortality was observed where branch samples were taken last year (see enclosed map). Additional observations indicated most of the Preserve's oak resource had some level of crown dieback. It appeared that some areas were more impacted than others. Additional branch samples were collected to determine if the two-lined chestnut borer was again present. It is most probable that the insect is present throughout the oak resource at varying levels.

In discussions with Steve Kresl, a need was identified to determine extent (geographical) and intensity (dieback and mortality) of impacts. Steve suggested it may be possible for the Preserve to conduct an aerial survey of the impacted areas this summer after full leaf flush (during our visit leaf flush was about 25 percent on oaks observed) to determine the extent of the oak crown dieback and mortality. Depending on the time of the flight, I suggested I might be available to assist with this survey. Arden Tagestad has offered to determine intensity of attacks by estimating crown dieback and tree mortality percentages using point sampling techniques in impacted areas identified by aerial survey. Combined, these two surveys should give us a good indication of the extent and intensity of impacts associated with the borer on the oak resource.

Literature suggests that control of the borer, under forest conditions is impractical. However, a parasitic wasp, *Phasgonophora sulcata* Westwood, can and does play a role in limiting populations of the beetle. Reductions in beetle populations by this wasp have been quantified at around the 10 percent level. Other than actions of this parasite, if present, the best we can hope for at the present time is an improvement in moisture levels this spring and summer.

A looper in the family Geometridae, suspected to be that of the fall cankerworm *Alsophila pometaria*, Harris (samples were taken of the first instar larvae, but as of this date have not been positively identified as those

of the fall cankerworm) was also found in sufficient numbers to be noticeable on clothing and vehicles. Populations of the fall cankerworm are usually cyclic in nature with outbreaks lasting between 3-4 years. Populations then remain at endemic to low levels for 12-18 years under normal conditions. The cycle may then repeat itself. Collapse of outbreaks is usually associated with starvation, parasitism and predation, a reduction in food quality associated with repeated defoliations, and/or adverse weather conditions. The fall cankerworm often times will be found with its associate, the spring cankerworm, *Paleacrita vernata* (Peck). Both species will feed on many different kinds of hardwood trees at the same time of year, and will cause similar damage. Among these, and which are present on the Preserve, are green ash, bur oak, basswood and American elm.

The future impacts of cankerworms on the Preserve's tree resource are difficult to assess without further sampling. We are currently cooperating with the Theodore Roosevelt National Park, Knife River Unit in assessing spring and fall cankerworm impacts on their tree resource. Methods developed there to quantify population levels and impacts should be applicable to the Preserve's tree resource. We can assist the Preserve in beginning this process, if desired. I have enclosed, for your information, copies of two trip reports that we sent the Park in conjunction with our cooperative efforts there.

Also observed on the green ash were conks associated with stem decay. Similar conks have been observed on green ash located in the Knife River Unit of the Theodore Roosevelt National Park.

Combined, these organisms indicate declining forest health. Other contributing factors to this decline are certainly the drought conditions present in North Dakota for the past 3 years. Negative affects on forest health associated with compaction by herbivores and the presence of coarse soils on ridge tops are unknown at this time. Very little regeneration of the dominant tree species now existing on the Preserve was observed.

In summary, it is too soon to tell the exact extent and intensity levels of the two-lined chestnut borer without further sampling. The situation is the same for the looper which was found on the Preserve. The first order of business should be to obtain an aerial sketch map of the impacts by the borer on the oak resource and then follow up with point sampling to determine intensity of impacts. We can discuss the steps necessary to assess the impacts associated with cankerworms at a later time if desired. I would recommend a discussion of management options take place after we have gathered data on impacts, and information on ecological processes associated with the Preserve's ecosystems is obtained.

If you have any comments, questions or concerns regarding this trip report, please call me at (406) 329-3428 or Arden Tagestad at (701) 228-2633.

/S/ WILLIAM L. ANTROBIUS

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Enclosures

Appendix B. Forest types and permanent plot locations for Sullys Hill National Game Preserve, North Dakota, 1991.

(map)

Appendix B. Plot and stand locations for Sullys Hill National Game Preserve.